Chemical & Engineering NEWS

New productivity measures for the chemical industry Page 12

First news from chemical congress in Las Vegas

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Chemical & Engineering NEWS

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News of the Week

- ***More than 10,000 registrants*** *enjoyed the Las Vegas congress; despite the last-minute switch from its original San Francisco site, operations ran smoothly.* ***Page 4***
- ***News on the science front*** *from the Second Chemical Congress of the North American Continent includes development of benzimidazole derivatives that show promise of curing colds, deep natural gas reservoirs in Gulf Coast basin, effects of Yucatán oil spill, and unusual poster session.* ***Page 5***
- ***People and places*** *filmed at the Las Vegas chemical congress include the city's mayor, keynote speaker Brown.* ***Page 6***
- ***Elimination of reproductive hazards*** *in the workplace was the subject of a Washington, D.C., conference of workers, union leaders, and social activists.* ***Page 8***
- ***Fragments of the human X chromosome*** *have been cloned for the first time by Johns Hopkins researchers who grew DNA from human cells in bacteria.* ***Page 8***
- ***Ethanol production will not meet 1990 goals*** *set by the Department of Energy unless steps are taken to ensure a market, industry consultant predicts.* ***Page 8***
- ***Process to remove residual polychlorinated biphenyls*** *from specialty industrial oils, developed by Goodyear, will go into the public domain.* ***Page 9***
- ***Celanese Corp. and Virginia Chemicals,*** *largest U.S. producer of sodium hydrosulfite, have agreed to merge pending VC stockholders' approval.* ***Page 9***

Business

- ***American Productivity Center's*** *new total-factor indexes bear out U.S. industry's productivity drop.* ***Page 12***

International

- ***Mexico aims for self-sufficiency*** *in fertilizers, plans to tap Baja California phosphate and potash resources.* ***Page 15***

Government

- ***U.S. Presidential candidates*** *Anderson, Carter, and Reagan run on diverse views on science and R&D.* ***Page 18***
- ***J. Herbert Hollomon*** *seeks to integrate technology with economic policy and the social contract at MIT center.* ***Page 19***

Science

- ***Stereoselectivity*** *of hydrogenation of olefins clarified by the discoveries of an important reaction step and structure of catalyst intermediate.* ***Page 26***
- ***Aerosol process*** *gives control over direct fluorination reaction, researchers tell Las Vegas congress.* ***Page 28***
- ***EPA's water quality criteria*** *cited for improper data collecting and manipulation by biologists at chemical congress.* ***Page 29***
- ***Yuriy Yarim-Agaev,*** *dissident Soviet polymer scientist permitted to leave the U.S.S.R., visits society headquarters.* ***Page 30***

Chemical & Engineering News

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Letters

ACM and human rights

SIR: My attention has been called to the letter in C&EN, May 19, from Peter Lykos concerning the actions of the Association for Computing Machinery (ACM) in the human rights arena.

There was, indeed, as Lykos states, a ballot of the ACM membership in 1969. The question put was: "Shall the Constitution of the ACM be revised to permit Association comment or action in deeply political and social questions?" Answer, No, by four to one.

As always on such matters, controversy focuses on the interpretation of the action. I have consistently believed and so, too, have a majority of the ACM officers and Council, that the membership was telling us not to be involved in political and social questions with *no computing component* but that, when activities in support of our normal educational and scientific function also had political and social overtones, we were not barred from such actions. All of ACM's human rights activities and, I believe, those of other American scientific and engineering societies, have adhered to this principle.

The C&EN News Forum, April 21, page 37, on scientists and international politics was a careful look at both sides of this issue. I remain convinced that scientific societies are as effective a vehicle as exists for pursuing the human rights of persecuted colleagues, wherever they may be. And I have yet to see an iota of evidence that such activity weakens a society internally or reduces its influence externally. On the contrary, a perception by the world at large that scientists are also aware and caring human beings can only help us in influencing decisions on science that increasingly often have, like it or not, political and social components.

Anthony Ralston

Chairman, ACM, Committee on Scientific Freedom & Human Rights; (Past President of ACM, 1972–74), New York City

More on the pictograph

SIR: I would like to clarify some confusions that might have been caused by Kwang-Ting Liu's letter (C&EN, July 7, page 40). He emphasized the pictograph now used by the Chinese to denote steroid (R. J. Seltzer, C&EN, Dec. 17, 1979, page 25) was invented in the Han Dynasty and the Chinese chemists "borrowed" it and not "invented" it.

Let me point out that this pictograph (more correctly this Chinese word) was *invented* by the Chinese in the Han Dynasty carrying a different meaning and is now *used* by the Chinese to denote steroid. In the translation of nouns we are looking in one language for a word or a group of words that have the same meaning as a word in another language. This equivalence in meaning can be existing or assigned. The Chinese have taken a word in their vocabulary and assigned the meaning "steroid" to it. In other words they invented a new meaning for the already existing word. It is unequivocal that the Chinese invented the word and the Chinese use it.

Cheuk-Chung Yau

Kingsport, Tenn.

Feasibility of gasohol

SIR: In his letter about saving energy in gasohol production (C&EN, July 21, page 4) S. Arora raises the question of the feasibility of using gasoline to extract alcohol from an aqueous solution thereof and thereby saving the energy and capital associated with making anhydrous alcohol. Arora concludes, "Only an experiment will tell."

Well, the experiment's been done, quite some time ago, as a matter of fact. It worked fine within the limits of an unhappy phase diagram, and patent activity was initiated. However, there just didn't seem to be many locations where it would be logistically attractive to run 9 gal of gasoline into and out of the alcohol distillery for every gallon of alcohol made there. We therefore turned our attention to alternatives with some success.

At this point, because we're talking with candidate licensees, we can say only that we're very excited about our latest modification.

A. P. Gelbein

Director of R&D, ChemSystems Inc., Fairfield, N.J.

Nuclear safety—a rebuttal

SIR: Denis Burman has taken issue in C&EN June 23, page 4, with my letter in C&EN, March 31, page 3, in which I stated that "there is no

Correction

• Aug. 11, page 13: Stock market data are scrambled for final three companies in the earnings table for diversified chemical producers. Correct data are:

	Stock price			Price-earnings ratio	Annual indicated dividend	Dividend yield, % of price
		Recent 12 months				
	July 31	High	Low	July 31		
General Tire	$17	$23 7/8	$12 1/4	13	$1.50	8.8%
National Distillers	28 3/4	32 1/2	22	7	2.00	7.0
NL Industries	49 3/4	51 7/8	23 7/8	12	1.20	2.4

New measures bear out productivity drop

Total-factor productivity indexes underscore gravity of U.S. productivity mass, show clearly that it touches the chemical industry

Bruce F. Greek
C&EN, Houston

The old saying, you can't define something you can't measure, applies with a vengeance to U.S. industry's productivity problem. Although everyone agrees that something is radically wrong and getting worse, it has been hard to say exactly how bad it is, how it got that way, and what to do about it.

Theories abound, from poor labor efficiency to deteriorating management to slowed capital formation to sluggish support of research and development. But the truth is, productivity is still somewhat of a mystery, even though its growth is a simple concept: Output grows faster than labor, capital, and other inputs.

A large part of the mystery is that productivity measures haven't been very good. The partial industry measures to date from the government have concerned only labor productivity, which for an industry like chemicals is a small part of total productivity.

A bold stroke on the statistics front now comes from the American Productivity Center in Houston. APC is offering a new data service providing indexes on "total-factor" productivity for all major sectors of the U.S. private business economy, including the chemical industry.

Although not as yet a true "total" productivity series, the new indexes represent a significant step in the right direction, according to C. Jackson Grayson Jr., chairman of APC. Containing a new factor for real-dollar capital inputs, these indexes are superior to productivity measures based entirely on labor input, especially for industries like chemicals that are capital intensive. In addition, the new indexes cover whole industries in line with standard measures such as production and employment.

A complete total-factor productivity measure also would include factors for energy and raw materials inputs. APC is working on this grand design and intends eventually to offer it as a companion service.

Total-factor productivity indexes now offered cover the years 1948 through 1978 for specific industries

Productivity growth is way down although capital inputs have risen faster than labor

Index, 1967 = 100	1978	1977	1976	1975	1974	1973	1972	1971	1970	1969	1968
Total-factor productivity											
Chemical industry	134.0	133.3	130.3	123.2	122.5	135.1	128.3	118.5	112.7	112.4	110.1
All manufacturing	120.1	118.7	114.8	109.4	107.2	114.4	110.9	105.3	101.2	103.3	102.9
Output per unit labor											
Chemical industry	150.8	147.7	142.8	134.8	129.6	141.2	134.9	121.4	115.4	112.9	110.0
All manufacturing	129.1	127.8	123.9	119.2	113.1	118.9	115.9	110.9	105.2	104.9	103.9
Output per unit capital											
Chemical industry	113.7	115.2	114.1	108.0	112.4	126.2	118.6	110.2	108.2	111.3	109.7
All manufacturing	101.3	99.8	95.8	89.5	94.4	104.8	100.0	93.2	92.8	100.8	101.8
Real output											
Chemical industry	164.7	158.0	148.4	134.3	136.7	146.8	136.2	125.2	120.9	120.0	113.8
All manufacturing	134.5	128.2	119.5	109.1	114.9	123.2	113.7	104.0	102.6	108.7	105.6
Labor input											
Chemical industry	109.2	107.0	103.9	99.6	105.5	104.0	100.9	100.9	104.7	106.3	103.5
All manufacturing	104.1	100.4	96.5	91.5	101.6	103.6	98.1	93.8	97.5	103.6	101.7
Capital input											
Chemical industry	144.9	137.1	130.1	124.3	121.6	116.4	114.3	113.6	111.7	107.8	103.7
All manufacturing	132.7	128.5	124.7	121.9	121.7	117.6	113.7	111.6	110.5	107.9	103.8
Capital-labor ratio											
Chemical industry	132.7	128.2	125.2	124.8	115.3	111.9	113.7	112.7	106.6	101.4	100.2
All manufacturing	127.4	128.1	129.3	133.2	119.8	113.4	116.0	118.9	113.3	104.1	102.1
Total-factor input											
Chemical industry	122.9	118.5	113.9	109.0	111.6	108.7	106.2	105.7	107.3	106.7	103.4
All manufacturing	111.9	108.0	104.1	99.7	107.2	107.7	102.5	98.8	101.3	105.2	102.7

Source: American Productivity Center

and through 1979 for industry as a whole. Overall data for private U.S. business show compound annual growth in output of 3.6% over three decades. At the same time, labor and capital inputs rose a combined 1.3%, leaving total-factor productivity rising at 2.3%.

For the chemical industry, the 30-year annual compound output growth was a bit under 5.8%. Inputs rose 2.8% per year, and total-factor productivity 2.9%. For all manufacturing, output grew 3.5% per year, inputs 1.4%, and productivity 2.0% (the numbers don't add up exactly because of rounding).

So far, chemicals look pretty good. But closer examination reveals disturbing trends, which add up to a slowing in productivity growth, more so in recent years for chemicals than for manufacturing as a whole.

Chemicals continued to outgrow manufacturing in relative productivity from 1965 to 1973 with annual growth of 3.6% compared to manufacturing's slowed 1.8%. However, after that the real trouble started in an environment of overinvestment, severe recession, and reduced product growth. From 1973 through 1978, APC data show the chemical productivity rate falling all the way to an average 0.2% yearly decline. Manufacturing productivity growth eased to 1.0% per year.

The ratio of capital to labor in business inputs grew even faster in the most recent 10 years for both chemicals and all manufacturing. As C&EN and other surveys show, both groups' role in job formation has slowed drastically in recent years. However, even a relatively greater role for investment capital in chemical industry growth couldn't stop a decline in productivity growth.

The decline in total-factor productivity growth for all manufacturing and many of its segments, in-

Total-factor productivity considers variety of inputs

Although more complicated than older measures, total-factor productivity provides a much more comprehensive way to treat the major influences on production efficiency. In equation form, it looks like this:

Total-factor productivity = Output/Capital + Energy + Labor + Materials (inputs)

That is, productivity is physical output per unit of capital, unit of energy, unit of labor, and unit of raw material.

By contrast, the older concept of productivity as only output per unit of labor leads to distortions. In particular, it doesn't take into account substitution of capital for labor and thus overstates gains in labor efficiency. Total-factor indexes run lower than conventional productivity measures.

Put another way, the new indexes show an apparent dampening effect on productivity gains from relatively greater capital use. Some of this is logical. For example, capital represented by environmental equipment has no effect on output and thus lowers productivity gains. But much of the problem is still a mystery even to the experts.

Total-factor productivity measures also help avoid confusion between production and productivity. Production gains tell nothing about productivity without examination of the relative levels of the four major inputs.

Finally, the new indexes are a step toward linking profitability and productivity. Profitability is productivity times "price recovery." Price recovery is the change in the price of a unit output compared to the change in cost of the various units of input. It's what company people mean by "cost passthroughs" and similar terms.

1967	1966	1965	1964	1963	1962	1961	1960	1959	1958	Average annual change, % 1968–78	1958–68
100.0	102.5	101.5	96.8	91.1	83.1	79.1	77.1	78.9	70.9	2.0%	4.5%
100.0	100.8	99.3	96.0	91.4	85.7	81.9	81.1	80.4	76.4	1.6	3.0
100.0	101.9	100.7	95.7	89.6	81.7	78.2	75.6	76.9	69.1	3.2	4.8
100.0	99.3	97.9	95.1	90.3	84.4	81.1	79.5	78.4	75.5	2.2	3.2
100.0	103.2	102.4	98.2	93.0	84.8	80.3	79.1	81.6	73.2	0.4	4.1
100.0	105.2	103.5	98.6	94.5	89.3	84.1	85.7	86.5	79.1	−0.1	2.6
100.0	98.8	92.4	84.4	78.0	69.9	65.0	62.7	62.5	54.2	3.8	7.7
100.0	100.0	92.6	84.9	79.1	73.3	67.4	67.7	67.2	60.3	2.5	5.8
100.0	96.9	91.8	88.2	87.0	85.6	83.2	83.0	81.3	78.4	0.5	2.8
100.0	100.7	94.5	89.3	87.6	86.8	83.1	85.2	85.7	79.9	0.2	2.4
100.0	95.7	90.2	86.0	83.8	82.5	81.0	79.2	76.6	74.1	3.4	3.4
100.0	95.0	89.5	86.1	83.8	82.1	80.2	78.9	77.7	76.3	2.5	3.1
100.0	98.8	98.3	97.4	96.4	96.4	97.4	95.5	94.3	94.5	2.9	0.6
100.0	94.3	94.6	96.4	95.6	94.5	96.5	92.7	90.7	95.5	2.2	0.7
100.0	96.4	91.1	87.2	85.6	84.2	82.2	81.3	79.2	76.5	1.7	3.1
100.0	99.2	93.2	88.4	86.6	85.6	82.3	83.5	83.6	79.0	0.9	2.7

Celanese Chemical uses three-pronged approach to improve productivity

"Recommitment to productivity improvement" is how Huey P. Prater, productivity manager of Celanese Chemical, terms his company's program for tackling a job facing most of U.S. industry. After three years, Prater claims Celanese Chemical has tangible results from its efforts. For example, at one major complex in Bishop, Tex., a three-year program shows a 15% improvement in productivity.

Other Celanese Chemical units have similar programs in what is called "productivity management." The basic objective of these programs is to integrate productivity improvement into the mainstream of management, Prater says, as part of the long-range development of the corporation.

This longer-term outlook differs radically from most day-to-day industry planning. At Celanese Chemical, longer term means productivity planning over a two- to three-year period.

The Celanese Chemical program falls into three major segments—productivity awareness, productivity monitoring (a form of scorekeeping), and employee awareness.

Productivity awareness is largely up to Prater. In effect, he becomes a member of a plant manager's staff for a short period. During this time, he conducts informal interviews of a cross section of plant personnel to discover their opinions on major productivity problems at the plant and ways to correct them.

At the same time, Prater analyzes plant statistics of many kinds—production efficiency, backlogs, overtime, and others. Engineering projects are studied for timeliness and the like. Outside influences such as vendor delays are not taken into consideration.

The monitoring or scorekeeping segment involves accounting department services. Computer programs are used to develop indexes similar to the new total-factor productivity indexes developed by the American Productivity Center. Prater spent a year at APC learning about productivity improvement.

Wherever possible, these new productivity measures use physical quantities such as pounds of production. Dollar figures are deflated to constant dollars. Indexes are used only when it isn't practical to obtain physical quantities.

Of the three segments in Celanese Chemical's productivity program, employee awareness falls shortest of the optimum, in Prater's opinion. The major reason is a lack of good means of communication. Celanese Chemical is slowly developing materials such as audiovisual aids, written material, and oral programs for this purpose and has used materials developed by APC and others.

Even so, it is the employee awareness segment that has produced the biggest surprise for Prater. Once the need is made clear, employees show a great willingness to participate in various programs, large and small, aimed at improving productivity.

When the productivity improvement program was begun in 1977, the Bishop complex was selected as a test case. The plant manager there, Paul E. Hime, was very interested in productivity improvement, and a large site with a diverse product slate was needed to ensure that results were generally valid.

Prater says that valuable results have come from the three-year program at Bishop. For example, this plant leads all Celanese Chemical plants in energy conservation.

Efficiency in raw materials use also has improved at Bishop, helping productivity. Frequently this is achieved by using new technology such as switching from a high-pressure to a low-pressure process for making methanol.

The three-year program at Bishop with its 15% productivity improvement typifies what productivity improvement is all about, Prater says. There is no magic solution; improvement requires dogged effort, time, patience, and real cooperation. However, Prater fully expects that total-factor productivity indexes will in time become a meaningful management tool.

cluding chemicals, has become widely recognized as the "stagflation" of the mid- and late 1970's. The total-factor productivity measurements help identify the core problems causing declines in productivity, says Carl G. Thor, vice president, measurement, of APC. Examples of these problems, he says, are the relatively low rate of capital formation in the U.S. because of high taxes and lack of business incentives common in other countries, a holdup in private R&D expenditures except for defensive work, and mandated heavy investment in environmental control equipment.

But Thor believes that identifying these problems, in part through better measurement, goes a long way toward their solution. The solution will involve a lot of management planning following comparison of productivity measures with other company analysis systems, goals, and management styles.

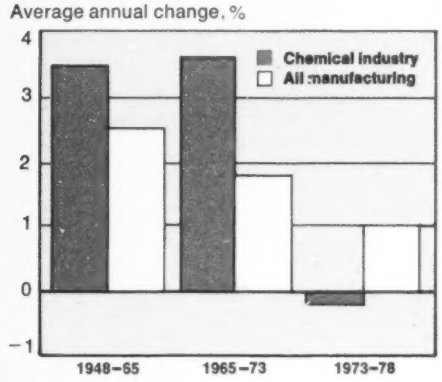
Even with such management backing, productivity campaigns have another serious hurdle—personnel cooperation. Productivity doesn't have a good general image, Thor admits. Many employees and managers believe that productivity efforts bring job risks or at least a call to work harder.

However, Thor says that new ways have been found to involve workers and managers in productivity improvement without losing the essential morale. Some U.S. industries such as aircraft and chemicals are adopting the Japanese "quality circle" technique of voluntary participation of a work group in suggesting improvements after discussing their work environments. Celanese Chemical, for instance, has used this and other techniques in a broad program to boost productivity.

APC's statistics development traces to an approach pioneered by John W. Kendrick, former chief economist of the Department of Commerce, former vice president of the Conference Board in New York City, and now a member of the APC board of directors. Data compilation is the work of Elliott S. Grossman, a former coworker of Kendrick's at the Conference Board and now professor at Pace University in New York City.

Although the APC indexes help clear up the nature of the U.S. productivity problem, for the moment many subscribers will wish they didn't know so much. For the chemical industry itself, the total-factor productivity index must be a jolt and could direct more management attention toward reversing the index's recent direction. □

Total-factor productivity in chemical industry has fallen



Source: American Productivity Center